

July 7, 2008

James M. Shuler
U.S. Department of Energy
EM-63, CLV-2047
1000 Independence Avenue, SW
Washington, DC 20585

SUBJECT: REVISION 8 OF CERTIFICATE OF COMPLIANCE NO. 9315 FOR THE MODEL
NO. ES-3100

Dear Dr. Shuler:

As requested by your letter dated October 11, 2007, as supplemented March 25, and May 30, 2008, enclosed is Certificate of Compliance (CoC) No. 9315, Revision No. 8, for the Model No. ES-3100 package. You requested a revision of the definition of pyrophoric uranium and to reduce two loading limits to zero in Table 2 of Condition 5.(b)(1) of the CoC. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's Safety Evaluation Report is also enclosed.

Those on the attached list have been registered as users of the package under the general license provisions of 10 CFR 71.17 or 49 CFR 173.471. This approval constitutes authority to use the package for shipment of radioactive material and for the package to be shipped in accordance with the provisions of 49 CFR 173.471. Registered users may request, by letter, to remove their names from the Registered Users List.

If you have any questions regarding this certificate, please contact me at (301) 492-3294 or Kim Hardin of my staff at (301) 492-3339.

Sincerely,



Eric J. Benner, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9315

TAC No. L24221

Enclosures: 1. Certificate of Compliance
No. 9315, Rev. No. 8
2. Safety Evaluation Report
3. Registered Users

cc w/encls 1 and 2: R. Boyle, Department of Transportation
Registered Users

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	9315	8	71-9315	USA/9315/B(U)F-96	1 OF	7

2 PREAMBLE

- a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."
- b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.
3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

- | | | | |
|----|---|----|--|
| a. | ISSUED TO (<i>Name and Address</i>) | b. | TITLE AND IDENTIFICATION OF REPORT OR APPLICATION |
| | U.S. Department of Energy
Washington, DC 20585 | | BWXT Y-12, L.L.C., application dated February 25,
2005, as supplemented |

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below

5.**(a) Packaging**

- (1) Model No.: ES-3100
- (2) Description

The ES-3100 package is a cylindrical container that is approximately 110 cm (43 in) in overall height and 49 cm (19 in) in overall diameter and is composed of an outer drum assembly and an inner containment vessel. The containment vessel is placed inside the drum and surrounded by a cement based borated neutron absorber, Catalog 277-4. The purpose of the ES-3100 is to transport bulk high enriched uranium in oxide form, uranium metal and alloy, and uranyl nitrate crystals.

The outer drum assembly consists of a reinforced stainless steel, standard mil spec 30-gal drum with an increased length. The volume formed between the drum and the attached inner liner is filled with an inorganic, castable refractory material, Kaolite 1600™, which is comprised of concrete and vermiculite. The Kaolite 1600™ acts as both a thermal insulating and an impact limiting material.

The containment vessel is approximately 82 cm (32 in) in overall height and 13 cm (5 in) in overall diameter and is constructed of 304L stainless steel. The containment boundary consists of the 0.1 in thick containment vessel body and the lid assembly. The lid assembly consists of a sealing lid, a closure nut, and external retaining ring, which holds both the assembly and closure nut together. The double ethylene-propylene elastomer O-rings in the top flange of the containment vessel permit leak testing of the containment vessel. The maximum gross weight of the package, including contents, is 190.5 kg (420 lb).

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	9315	8	71-9315	USA/9315/B(U)F-96	2 OF	7

5.(a) Packaging (continued)

(3) Drawings

The Model No. ES-3100 package is constructed and assembled in accordance with:

- (i) BWXT Y-12, L.L.C., Drawing No. M2E801580A037, Sheets 1 through 6, Rev. B, "Consolidated Assembly Drawing."
- (ii) BWXT Y-12, L.L.C., Drawing No. M2E801580A026, Rev. C, "Heavy Can Spacer Assembly."
- (iii) Equipment Specification JS-YMN3-801580-A001, Rev. E, "ES-3100 Containment Vessel."
- (iv) Equipment Specification JS-YMN3-801580-A002, Rev. D, "ES-3100 Drum Assembly."
- (v) Equipment Specification JS-YMN3-801580-A003, Rev. C, "Manufacturing Process Specification for Casting Kaolite 1600™ into the ES-3100 Shipping Package."
- (vi) Equipment Specification JS-YMN3-801580-A005, Rev. F, "Casting Catalog No. 277-4 Neutron Absorber for the ES-3100 Shipping Package."

5.(b) Contents (Type and form of material, maximum quantity of material per package, and Criticality Safety Index (CSI)).

The weight of the radioactive contents, convenience containers, can lift attachments, polyethylene bags, spacers, and other material in the containment vessel shall not exceed 90 lb. The maximum mass of hydrogenous packaging materials in the containment vessel (e.g., polyethylene containers or bagging, silicone rubber pads, etc.) shall not exceed 500 grams. The maximum content decay heat load shall not exceed 0.4 watts.

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	9315	8	71-9315	USA/9315/B(U)F-96	3 OF	7

5.(b) Contents (continued)

The concentration limits of uranium and transuranic constituents shall be the following:

Isotope	Maximum Concentration
U-232	0.040 $\mu\text{g/gU}^a$
U-233	0.006 g/gU ^b
U-234	0.02 g/gU
U-235	1.00 g/gU
U-236	0.40 g/gU
Transuranics (except Np)	40.0 $\mu\text{g/gU}$
Np-237	0.003 g/gU

^a $\mu\text{g/gU} = 10^{-6}$ grams per gram of total uranium

^b g/gU = grams per gram of total uranium

- (1) Uranium as solid metal or alloy, packaged in stainless-steel or tin-plated carbon steel convenience cans.

The maximum uranium enrichment is 100 weight percent U-235.

For contents that must be shipped with spacers, the spacers must be in accordance with BWXT Y-12, L.L.C., Drawing No. M2E801580A026 and Equipment Specification JS-YMN3-801580-A005, as specified in Condition No. 5.(a)(3). The quantity of fissile material in any convenience can shall not exceed one third of the mass loading limit per package for that content. Spacers must be positioned between every two convenience cans.

- (i) For metal and alloy in the form of solid geometric shapes, meeting the following restrictions, mass limits are listed in Table 1. Contents not meeting the following restrictions must be shipped as broken metal (see Condition No. 5.(b)(1)(ii)).
- (A) Spheres having a diameter no larger than 3.24 in.
(maximum of two spheres per convenience can)
 - (B) Cylinders having a diameter no larger than 3.24 in.
(maximum of one cylinder per convenience can)
 - (C) Square bars having a cross section no larger than 2.29 in \times 2.29 in.
(maximum of one bar per convenience can)
 - (D) Slugs having dimensions of 1.5 in diameter \times 2 in tall
(maximum of 10 slugs per convenience can)

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1 a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9315	8	71-9315	USA/9315/B(U)F-96	4 OF	7

5.(b)(1) Contents (continued)

Table 1: Loading Limits for Metal and Alloy in Solid Geometric Shapes

Solid uranium metal or alloy (specified geometric shapes)	Uranium Enrichment (weight percent U-235)	CSI	With Spacers Maximum Mass U-235 (kg)		No Spacers Maximum Mass U-235 Per Package (kg)
			Per Convenience Can	Per Package	
Spheres	≤ 100	0.0	0.000	0.0	0.0
Cylinders	≤ 100	0.0	6.000	18.000	12.000
Sq. Bars	≤ 100	0.0	10.000	30.000	18.000
Slugs	> 80	0.0	5.447	16.342	Spacer req'd
Slugs	≤ 80	0.0	8.738	26.213	Spacer req'd

- (ii) For metal and alloy defined as broken metal, mass limits are specified in Table 2. Uranium metal and alloy pieces must have a surface-area-to-mass ratio of not greater than 1.00 cm²/g or must not pass freely through a 3/8-inch (0.0095m) mesh sieve. The uranium metal must also have had no more than a limited contact with water and been subsequently dried. Particles and small shapes that do not pass this size restriction, as well as powders, foils, turnings, and wires, are not permitted, unless they are in a sealed container under an inert cover gas. Uranium material or alloy which has been stored in water or is visibly wet at the time of packaging is not authorized to be shipped in this package.

Table 2: Loading Limits for Solid Metal or Alloy in the Form Defined as Broken Metal

Uranium Enrichment (weight percent U-235)	CSI	With Spacers Maximum Mass U-235 (kg) ^a		No Spacers Maximum Mass U-235 Per Package (kg) ^a
		Per Convenience Can	Per Package	
> 95 and ≤ 100	0.0	0.925	2.774	Spacer req'd
	0.4	1.849	5.548	Spacer req'd
	0.8	2.774	8.323	Spacer req'd
	2.0	3.699	11.097	Spacer req'd

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1	a. CERTIFICATE NUMBER 9315	b. REVISION NUMBER 8	c. DOCKET NUMBER 71-9315	d. PACKAGE IDENTIFICATION NUMBER USA/9315/B(U)F-96	PAGE 5	PAGES OF 7
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5.(b)(1) Contents (continued)

Table 2 Loading Limits for Solid Metal or Alloy in the Form Defined as Broken Metal (Continued)

Uranium Enrichment (weight percent U-235)	CSI	With Spacers Maximum Mass U-235 (kg) ^a		No Spacers Maximum Mass U-235 Per Package (kg) ^a Spacer req'd
		Per Convenience Can	Per Package	
> 90 and ≤ 95	0.0	0.879	2.637	Spacer req'd
	0.4	1.758	5.274	Spacer req'd
	0.8	3.516	10.549	Spacer req'd
	2.0	5.568	16.703	Spacer req'd
> 80 and ≤ 90	0.0	0.833	2.500	Spacer req'd
	0.4	2.500	7.500	Spacer req'd
	0.8	3.333	10.000	Spacer req'd
	2.0	5.278	15.834	Spacer req'd
> 70 and ≤ 80	0.0	0.742	2.225	Spacer req'd
	0.4	2.967	8.900	Spacer req'd
	0.8	0.000	0.0	Spacer req'd
	2.0	7.911	23.734	Spacer req'd
> 60 and ≤ 70	0.0	0.000	0.0	1.949
	0.4	4.115	12.346	0.0
	0.8	6.931	20.793	0.0
	2.0	8.231	24.692	0.0
60	0.0	3.718 kgU	11.153 kgU	5.576 kgU
	0.4	0.0 kgU	0.0 kgU	0.0 kgU
	0.8	11.773 kgU	35.320 kgU	0.0 kgU
	2.0	11.773 kgU	35.320 kgU	35.320 kgU

^a All limits are expressed in kg U-235 unless specified as kgU, which means kilograms of total uranium.

CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES

1	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	9315	8	71-9315	USA/9315/B(U)F-96	6	CF 7

5.(b) Contents (continued)

- (2) Uranium as oxide, which may include UO_2 , UO_3 , and U_3O_8 , packaged in stainless-steel, tin-plated carbon steel, or nickel-alloy convenience cans, or polyethylene bottles. The physical form of all contents is dense, loose powder which may contain clumps and pellets. Moisture content in oxide is limited to 3 weight percent water. Carbide compounds are not authorized. The mass limit shall be 24.0 kg of oxide, with a maximum mass of 21.124 kg U-235, with a CSI of 0.0. The maximum uranium enrichment is 100 weight percent U-235. No spacers are required in the containment vessel.
 - (3) Solid uranyl nitrate in the form of uranyl nitrate crystals, $[\text{UO}_2(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}]$, where x is ≤ 6 . Uranyl nitrate crystals must be contained in a non-metallic convenience container (such as polyethylene bottles). The mass limit shall be 0.0 kg of uranyl nitrate crystals, with a maximum mass of 0.0 kg U-235, with a CSI of 0.0. The maximum uranium enrichment is 100 weight percent U-235. No spacers are required in the containment vessel.
 - (4) Unirradiated TRIGA fuel elements and pellets (sections). The fuel is composed of uranium zirconium hydride (UZrH). The uranium concentration in the fuel is a nominal 8.5 weight percent, and the maximum H to Zr ratio in the fuel is 2.0. The maximum uranium enrichment is 70 weight percent U-235. The fuel sections may be from any of three types of fuel elements: standard fuel elements, instrumented standard fuel elements, and fuel follower control rods. The U-235 mass for standard and instrumented fuel elements is a nominal 136 grams per element, and the U-235 mass for fuel follower control rods is a nominal 112 grams per element. Each fuel element contains three fuel sections, either stainless steel or aluminum clad or unclad. The fuel elements are approximately 15 inches in length, with sections approximately 5 inches in length; the approximate diameter of the fuel is 1.44 inches for the standard and instrumented fuel elements, and 1.31 inches for the fuel follower control rods. The fuel elements and sections are packaged within stainless steel or tin-plated carbon steel convenience cans. Disassembled fuel elements are to be packaged with a maximum of three fuel sections, or three fuel elements, per convenience can. Fuel sections from different fuel elements may not be mixed within a single convenience can. A maximum of three convenience cans with disassembled fuel elements may be loaded into a single package. Three stainless steel or aluminum clad elements with crimped ends are to be packaged in a single convenience can with a maximum of one can per package. No spacers are required. The maximum quantity of fissile material per package is 408 grams U-235. The CSI is 0.0.
6. The vent holes on the outer steel drum shall be capped closed during transport and storage to preclude entry of rain water into the insulation cavity of the drum.
 7. Content forms may not be mixed in a single ES-3100 containment vessel.
 8. Any combination of convenience can sizes is allowed in a single package, as long as the total height of the can stack (including silicone rubber pads and spacers, if required) does not exceed the inside working height of the containment vessel (31 in). Any closure on the convenience can is allowed.

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1	a. CERTIFICATE NUMBER 9315	b. REVISION NUMBER 8	c. DOCKET NUMBER 71-9315	d. PACKAGE IDENTIFICATION NUMBER USA/9315/B(U)F-96	PAGE 7	PAGES CF 7
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9. Empty convenience cans, spacers, silicone rubber pads, and/or stainless-steel scrubbers (i.e., stainless steel trimmings that act as dunnage) may be used to fill the void space in the containment vessel. Empty convenience cans must have a minimum 0.125 in diameter hole through the lid.
10. The contents and the convenience cans may be bagged or wrapped in polyethylene for contamination control provided the limits of Condition No. 5.(b) are met.
11. Transport by air is not authorized, except for shipment of unirradiated TRIGA fuel pellets, as described and limited in Condition No. 5(b)(4).
12. In addition to the requirements of Subpart G of 10 CFR Part 71:
- (a) The package shall be prepared for shipment and operated in accordance with the Package Operations in Section 7 of the application, as supplemented.
 - (b) Each package must meet the Acceptance Tests and Maintenance Program of Section 8 of the application, as supplemented.
13. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.
14. Revision 7 of this certificate may be used until July 31, 2009.
15. Expiration date: April 30, 2011.

REFERENCES

BWXT Y-12, L.L.C., application dated February 25, 2005, as supplemented.

BWXT Y-12, L.L.C., supplements dated April 27, May 26, August 15, 2005; and January 9, February 6, March 20, May 8, June 6, July 18, August 21 and 24, and October 26, 2006; and January 19, January 31, February 22, April 11, April 26, May 30, June 27 (2 supplements on this date), August 8, 28, 30, October 11, and November 5, 2007; and March 25 and May 30, 2008.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION



Eric J. Benner, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Date: July 7, 2008

SAFETY EVALUATION REPORT
Docket No. 71-9315
Model No. ES-3100 Package
Certificate of Compliance No. 9315
Revision No. 8

SUMMARY

By application dated October 11, 2007, as supplemented March 25, and May 30, 2008, the Department of Energy (DOE or the applicant) requested Revision No. 8 to Certificate of Compliance (CoC) No. 9315, for the Model No. ES-3100 package. This revision changes the definition of pyrophoric uranium and reduces two loading limits to zero in Table 2 of Condition 5.(b)(1) of the CoC.

The submittal was evaluated against the regulatory standards in 10 CFR Part 71, including the general standards for all packages, standards for fissile material packages, and performance standards under normal conditions of transport (NCT) and hypothetical accident conditions (HAC). Staff reviewed the application using the guidance in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material."

Based on the statements and representations in the application, as supplemented, and the conditions listed in the CoC, the staff concludes that the design has been adequately described and evaluated and meets the requirements of 10 CFR Part 71.

GENERAL INFORMATION

By application dated October 11, 2007, as supplemented March 25, and May 30, 2008, DOE requested a revision of the definition of pyrophoric uranium and to reduce two loading limits to zero.

The applicant has requested that the uranium metal described in Condition 5.(b)(1)(ii) be revised to allow limited contact between water and the uranium after which the uranium would be dried before packaging.

Additionally, for operational purposes, DOE requests that two entries in Table 2 of Condition 5.(b)(1) of the CoC be reduced to zero.

MATERIALS EVALUATION

The staff reviewed the application to revise the Model No. NAC-LWT package to verify that the materials requirements of the design have been described and evaluated under NCT and HAC as required in 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material."

The current CoC does not allow the shipment of uranium metallic particulate that has been in contact with or stored in water. The applicant has requested that uranium metal shavings that were in contact with water for a limited time and then dried be allowed as acceptable content. Based on expert opinion of persons intimately familiar with the uranium pyrophoricity issue,

there is no evidence that uranium metal that has had limited contact with water and been subsequently dried has an increased risk of pyrophoricity. The staff agrees that this material, as described, be an approved content, as long as it meets all other size and other restrictions in the CoC.

Additionally, for operational purposes, DOE requests that two entries in Table 2 of Condition 5.(b)(1) of the CoC be reduced to zero. These entries are in the >60% and ≤70% enrichment ranges under the "No Spacers" column. There are no safety implications involved with these changes. The loading values will be restored to an appropriate amount when a safety evaluation of a new analysis has been complete.

Based on the review of the application, as supplemented, the staff found reasonable assurance that the changes to the approved contents do not affect the ability of the package to meet the material requirements of 10 CFR Part 71.

CONDITIONS

The CoC has been revised as follows:

Condition No. 5.(b)(1)(ii):

Changes the description of uranium metal and alloy contents.

Condition No. 5.(b)(1)(ii), Table 2:

Reduces the maximum mass of uranium per package to zero in two entries.

Condition No. 14:

Allows the use of Revision 7 of this certificate for one year.

CONCLUSION

The Certificate of Compliance is revised to change the definition of pyrophoric uranium and reduce two loading limits to zero.

This change does not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9315, Revision No. 8 on
July 7, 2008.